IN THE SPECIFICATION

Please enter the following amendments:

1. Please add the first and second paragraphs on page 1, as follows:

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of Applicant's Serial No. 09/446,533 filed in the United States Patent & Trademark Office on the 24th of March 2000 and thereby assigned Serial No. 09/446,533, and subsequently issued on the 21st of October 2003 as U.S. Patent No. 6634060B1.

CLAIM OF PRIORITY

This application makes reference to, incorporates the same herein, and claims all benefits accruing under 35 U.S.C. §119 from an application for *COORDINATED MULTI-AXIS HINGE AND CLOSURE USING THE SAME* earlier filed in the World International Patent Organization on 27 January 1999, and thereby assigned serial no. PCT/IB99/00277.

2. Please amend the paragraph 1 on page 1, to read as follows:

The present application is generally directed to a snap hinge, particularly to a hinge usable in injection molded one-piece plastic closures.

3. Please amend the paragraph 2 on page 1, to read as follows:

The dispensing of consumable materials such as cosmetics and food stuffs ~~create~~ creates

a demand for dispensing closures which can be manufactured economically and which fully seal the container when in the closed position. Because such closures are often utilized in disposable containers for consumer goods, the cost of such closures is of substantial concern, as is the desire for closures which have excellent consumer convenience and a good tactile feel.

4. Please amend the paragraph 3 on page 1, bridging pages 1 and 2, to read as follows:

In the past, ~~many closures~~ a first class of closures employing a single main hinge connection or a plurality of main hinges aligned along a single axis ~~was~~ were often used. Some of these hinges employ an intermediate element such as a spring element or a taut band in order to produce a dead center position where tension within the closure will prevent the closure from stably resting in its position, driving the closure either more fully open, or more fully closed. Such an unstable equilibrium position is generally thought desirable in closures of this type as it provides the consumer with a closure with a generally good tactile feel. However, such single main hinge type closures, even provided with such an intermediate element, require significant offset of the main hinge from the closure contour due to the simple movement of the cap as illustrated in Figure 3 of the present application. These hinges are also difficult to mold due to asymmetrical flow paths during molding. This therefore places the hinge well outside the closure body, considered undesirable in such closures. Such single main hinge type closures are also often difficult to mold. An example of such devices employing a single main hinge include those disclosed by U.S. Patent No. 4,403,712 to Weisinger and U.S. Patent No. 4,638,916 to

5. Please amend the paragraph 3 on page 2, to read as follows:

A third class of hinges are coordinated multi-axis hinge arrangements which generally pivot about two hinge axes and are designed with two, typically tensionless, stable positions, namely a dead center or unstable equilibrium position being provided therebetween. In such a hinge, an over centering force tends to drive the hinge to one of two stable positions from the dead center position. Such hinges are believed to be the invention of an inventor of the present application and are best described in U.S. Patent No. 5,794,308 entitled "Hinge". Although at the time the '308 invention was invented, the model of Figure 1 of the present invention was not known, the invention of the '308 patent can generally be described with reference to this model. Such hinges employ a pair of hinge elements including a flexurally rigid intermediate hinge part 4 coupled to the first and second hinge parts, typically the body and lid of a closure via coupling elements 6, 7 which provide elastic relieving movement in the region of a dead center position.

6. Please amend the paragraph 2 on page 3, to read as follows:

It is accordingly an object of the present invention to improve upon the design of the aforementioned hinges by, at least in part, transferring the forces of distortion or deformation created by the flexurally or torsionally rigid intermediate parts or connecting arms to one or more resilient areas facilitating storage of this energy remotely from the coupling elements or areas

to which the flexurally rigid connecting arms are connected.

7. Please amend the paragraph 2 on page 4, to read as follows:

According to further teachings of the present application, the molds used to produce such a coordinated multi-axis hinge arrangement may be designed to compensate for mold shrinkage in the body, lid and connecting arms and still produce desired ~~geometry's~~ geometries. Optimal thin film hinges operate as efficient bending areas for the hinge.

8. Please amend the paragraph 4 on page 5, to read as follows:

Fig. 3 is a family of cinematic curves showing typical paths of a plurality of points in space rotating around a main hinge connection of the type ~~will~~ well known in the prior art;

9. Please amend the paragraph 1 on page 6, to read as follows:

Fig. ~~10a), 10b)~~ 10a, 10b shows paths of specific points in space of a hinge which constrains the first and second hinge parts into paths which interfere (Fig. 10a) and which ~~avoids~~ avoid interference (Fig. 10b);

10. Please amend the paragraph 4 on page 6, to read as follows:

Fig. 14 is a side view of another embodiment of a multi-axis hinge arrangement of the present application illustrating manufacturing shrinkage compensation ~~principals~~ principles; and

11. Please amend the paragraph 6 on page 6, to read as follows:

A better understanding of the present invention may be [[had]] achieved through an examination of the present detailed description which, when examined in connection with the accompanying drawings, sets forth preferred embodiments of the ~~inventions described herein~~ present invention. It should be understood that like elements in the various figures are generally identified with like reference numbers.

12. Please amend the paragraph 7 on page 6, to read as follows:

During the course of development of various coordinated multi-access hinge arrangements, the inventors have discovered that such a hinge may be described with reference to the mechanical model 1 of the coordinated multi-axis hinge arrangement [[is]] illustrated in Figure 1 of the present application. The mechanical model 1 of the multi-axis hinge arrangement has been discovered by the inventors as a way to describe the operation of the coordinated multi-axis hinge arrangement in its most general or basic form. The mechanical model 1 of a coordinated multi-axis hinge arrangement includes a lower or first hinge part 2, an upper or second hinge part 3, and at least one connecting arm 4 connecting the lower or first hinge part 2 and upper or second hinge part 3 via first and second rotational axes 5, 6. Note that while in

the embodiment of Figure 1, these axes are illustrated as parallel, it is possible to skew these axes with respect to each other in either of two dimensions.

13. Please amend the paragraph 1 on page 7, to read as follows:

A coordinating device 7 provides the coordination for the multi-axis hinge arrangement. In the mechanical model of Figure 1, the coordinating device 7 is represented by two pairs of mating bevel wheels 8, 9 and a transmission or gearbox 10 which may have any suitable coupling ratio, allowing the rate of pivot of the hinge about the first and second rotational axes 5 and 6, to differ in accordance with the transmission ratio selected for ~~the gear box~~ gearbox 10. Alternatively, as may be desired to achieve special effects, the transmission ratio of the gearbox 10 may be made non-linear. However, it is within the contemplation of the present invention that some defined coordination exists between the pivoting of the lower and upper hinge parts 2, 3, ~~to the~~ and connecting arm 4.

14. Please amend the paragraph 1 on page 9, to read as follows:

In the case of closures, [[if]] it is desirable to remove a lid as represented by the rectangle 20 to an open position well away ~~well~~ from the closure body. In such a single hinge arrangement, the main hinge connection 21 must be spaced well away from the container to accomplish this objective. This produces a substantial protrusion from the closure body, [[a]] an aspect of such single hinge closures considered undesirable.

15. Please amend the paragraph 3 on page 9, to read as follows:

Figure ~~4a)~~ 4a shows a first typical path pattern P2 of points within the rectangle 22 as it pivots 180° around a coordinated multi-axis hinge arrangement 1 as illustrated in Figure 1, for example. It is apparent that, because there is no main hinge, the rectangle 22 in the closed position 22.1 is displaced a significant distance by the coordinated multi-axis hinge arrangement 1 into the open position 22.2. Both of these positions 22.1 and 22.2 may be considered stable positions where no substantial resilient stress is stored in the hinge parts 2, 3. The path pattern P2 is clearly not circular. Thus, it is apparent from this example that a coordinated multi-axis hinge arrangement may be designed to prevent one element from interfering with specific other elements.

16. Please amend the paragraph 4 on page 9, to read as follows:

By modifying the distance of the rotation axes 5, 6 in space and the transmission ratio of the coordinating device 7, substantial effect can be [[had]] achieved on the path pattern and nearly any desired path can be realized. Examples of two further possible path patterns are illustrated in the cinematic diagrams of Figures ~~4b) and 4c)~~ 4b and 4c. It is very important to understand that substantial contact between the upper and lower hinge parts or, in a practical example, a closure which employs a hinge such as illustrated in Figure 1, must generally be avoided to achieve the desired motion. (Compare, however Figure 10a and 11 which make use of intentional interference to produce a latching action.) It is apparent from Figures 4b and 4c

that, as compared to a single main hinge connection as illustrated by the cinematic of Figure 3, many different requirements may be fulfilled by adjusting the parameters of a coordinated multi-axis hinge arrangement as taught herein.

17. Please amend the paragraph 3 on page 10, to read as follows:

Each connecting arm 33.1, 33.2 of Figure 5 is connected to a coupling portion of the body 31 and the lid 32 of the closure 30 by bending regions 34.1-34.4 which may be, in a preferred embodiment, film hinges. The bending regions 34.1-34.4 are arranged in this embodiment such that each connecting arm 33.1, 33.2 is trapezoidally shaped. Although the bending regions are shown symmetrically in Figure 5, an asymmetric arrangement of the bending regions 34.1-34.4 is also possible within the contemplation of the present invention, and would result in the same effect as changing the transmission ratio of the coordinating device 7 of the mechanical model of Figure 1. The coordination between the hinge parts [[2, 3]] <u>31, 32,</u> is achieved by the physical arrangement of the bending regions 34.1-34.4 in space and the design of the connecting elements 33.1, 33.2. In this style of hinge, two types of coordination are obtained. The first type of coordination is the coordination between the multiple hinge axes such as already described. A second type of "coordination" is the lateral and torsional stability of the hinge which increases as the hinge travels over its intended path from open to closed. This is particularly important since this second form of stability allows mechanized closing of the closure. Absent this lateral and torsional stability, the hinge would not self center on the closed position and the closure could not be used in automated filing and packaging machinery. Further details of this

relationship will be explained hereinafter.

18. Please amend the paragraph 1 on page 12, to read as follows:

When the closure 30 is opened or closed, the geometry of the connecting elements 33.1, 33.2 causes specific deformation of the structure of the hinge area. The degree and extent of deformation of various aspects of the closure geometry is dependent on the angles ω and ϕ, and [[of]] an opening angle α of the closure. In one preferred embodiment of the present application, the structural deformation is designed to be zero at times when the closure 30 is in a stable position, in the exemplary embodiment, the fully opened and fully closed position, with α being zero in the fully closed position and α having the designed maximum angular value in the fully opened position. However, structural deformation and its corresponding accumulation of force can be designed into a closure in any position, for example the fully closed position.

19. Please amend the paragraph 4 on page 12, to read as follows:

The connecting elements 33.1, 33.2 are desirably trapezoidally shaped as a truncated base of a triangle. The shorter edges of 36.1, 36.2 which serves to truncate the triangles, producing the trapezoidal connecting elements 33.1, 33.2, are subject to compression forces when, resisting these compression forces to produce deformation forces for application to another portion of the closure structure as illustrated in 35.3, 35.4, 35.5, and [[35.8]] 35.6. Similarly, the longer edges

37.1, 37.2 of each connecting element are subjected to tension during the hinge closure process and produce deformation forces 35.1, 35.2, [[35.6]] 35.8, and 35.7. Thus, each of the connecting arms 33.1, 33.2 supplies a force to the remainder of the closure structure which must be absorbed, in some fashion, by resilient deformation. The importance of this resilient deformation and the resiliency of the body 31 and lid 32 of the closure will be described in greater detail with reference to Figures 7 and 8.

20. Please amend the paragraph 1 on page 14, to read as follows:

Figure 7 is a further explanation of the embodiment of Figure 6 and shows significant inventive features of the present application. The importance of these features may be best understood after an understanding of the operation of the '308 patent already discussed above. In the '308 patent, as illustrated, for example, in Figure 6 thereof, a substantially flexurally rigid intermediate part 4.1, 4.2 of each hinge element is connected to the body and lid with upper and lower coupling elements 6.1, 6.2, 7.1, and 7.2 which correspond generally to coupling or transmitting areas or regions 45.1, 45.2 of the body 31 of the closure 30 as illustrated in Figure 7. Of course, equivalent coupling elements to the body coupling elements 45.1, 45.2 are also provided on the cap 32 of the closure 30 in accordance with the teachings of the present application.

21. Please amend the paragraph 2 on page 14, to read as follows:

As explained in the '308 patent, the coupling elements are elongation relieving elements of a resilient nature. While the equivalent portions of the present application, the coupling or transmitting areas 45.1, 45.2 may be resilient, the present application transmits some or all of this force to adjacent resilient areas including resilient area or region 40.2 provided between the coupling or transmitting areas 45.1, 45.2, and the resilient areas or regions 40.1, 40.3, provided on opposed sides of the coupling or transmitting areas 45.1, 45.2.

22. Please amend the paragraph 1 on page 15, to read as follows:

Figure 7 illustrates this transfer of deformation forces into one of the resilient areas 40.1-40.3. Referring once again to Figure 6, the structural deformation forces are illustrated by arrows 35.1-35.8. These forces are transmitted from the coupling or transmitting areas 45.1, 45.2 as illustrated in Figure 7 by arrows 50.1-50.4. In accordance with the teachings of the present application, these resilient areas 40.1-40.3, alone, or in conjunction with the coupling or transmitting areas 45.1, 45.2 function as energy accumulating buffers to temporarily store the structural deformation or distortion energy which may be later returned to the hinge to provide snap action closure or opening to one of the hinges stable states. When energy is released from the resilient areas 40.1-40.3, it is transmitted back to the hinge via the same paths indicated by arrows 50.1-50.4, but of course in the opposite way to that delivered.

23. Please amend the paragraph 2 on page 15, to read as follows:

According to the teachings of the present application, the energy supplied to the hinge to drive it from one stable to another is absorbed by induced structural deformation. Whereas in the '308 patent, the energy was absorbed entirely within the coupling or transmitting areas 45.1, 45.2 in the present invention, and, in accordance with the teachings of Figure 7, some or all of this energy is transmitted to the adjoining resilient areas 40.1-40.3. Thus, if the designer designs the coupling or transmitting areas 45.1, 45.2 to be substantially rigid, substantially all deformation energy is transmitted to the adjacent resilient areas 40.1-40.3. Alternatively, within the contemplation of the present application, the designer may design the closure so that some energy is buffered in the coupling or transmitting areas 45.1, 45.2 while some area is transferred to the adjacent resilient areas.

24. Please amend the paragraph 2 on page 17, to read as follows:

Figure 8 shows a schematic diagram of an alternative embodiment of the invention. Figure 8 principally differs from Figure 7 in that the outer, longer edges 51.1, 51.2 of the connecting elements 33.1, 33.2 are spatially curved. This may be primarily for the purpose of improving the design integration in a specific closure design such as illustrated in Figure 13. However, in this example, the curved areas along the outer edges 51.1, 51.2 of the connecting elements 33.1, 33.2 can be used as energy accumulating buffers providing additional bending deformation. In this circumstance, areas along the inner edges 52.1, 52.2 must nevertheless be built with sufficient stiffness to prevent buckling or bending as previously discussed, thereby providing the required torsional stiffness to cause each entire connecting elements 33.1, 33.2 to

be torsionally stiff.

25. Please amend the paragraph 3 on page 17, to read as follows:

In this embodiment, some deformation force is also transmitted to the coupling or transmitting elements 45.1, 45.2 and further to the resilient areas ~~40.1-40.3~~ 50.1-50.9. In this embodiment, the coupling or transmitting elements and resilient areas are less clearly defined, with respect to each other, the entire localized area of the body 31 functioning as an energy accumulating buffer. Similarly, it should be understood that all of the description of transmission of forces, with respect to Figure 7 and 8, although described specifically with respect to the body 31 of the closure30, equally apply to the lid 32 of the closure 30. It should be understood that in accordance with the principals of the present application, it is not necessary to accumulate energy in both the body and lid. However, at least one resilient area must be provided in the body, lid, or connecting arm in accordance with the teachings of the present application.

26. Please amend the paragraph 1 on page 19, to read as follows:

The rectangle [[55]] 54 shows schematically the back portion 55 of the lid 32 (which extends downwardly from the lid 32 in the closed position) in the area of the points P' and P" in a closed position (55.1) and in open position (55.2). The two dotted curves 56.1 and 56.2 show the movement of the two points P' and P" in space as the closure is moved between the

open and closed positions. It is obvious that the two points P' and P" of rectangle 55 collide with the rectangle 54. This means that the lid 32 of closure 30 would, in this case, collide with the body 31. This collision can be avoided in accordance with the teachings of the present application. This can be done, by moving the points P' and P" on specific, suitable pattern paths as shown in the cinematic curves of figures ~~4a) to 4c)~~ 4a and 4c.

27. Please amend the paragraph 3 on page 20, to read as follows:

The closure of Figure 11 is built with a locking mechanism. The points P' and P" collide in a desirable and controlled manner with the body 31 such that the coordinated multi-axis hinge arrangement is locked or latched. The hinge can be pressed on the back of the body [[51]] 31 near point P'1 to release the latch. The latching mechanism is described in detail in Swiss Patent Application No. 0981/98 filed April 30, 1998, which is hereby incorporated by reference into the present application.

28. Please amend the paragraph 1 on page 21, to read as follows:

The parting plane 60 of the closure 30 is indicated by numbers 60.1, 60.2, and 60.3 of Figure 12. Points P' and P" are arranged in this embodiment on a surface 61, thus shown in Figure 14, which is located a vertical distance E, as best shown in Figures ~~10b)~~ 10b and 14 from the parting plane 60. The distance E is chosen so that no collision between the lid 32 and body 31 occurs at any time. The plane 61 is desirably inclined with respect to the parting plane 60 by

the angle δ as illustrated in Figures 10 and 14. Plane 61 corresponds, in a closed position of the closure 30, with a surface [[62]] 60.2 of the body 30 such that no gap exists and optimal design is achieved.

29. Please amend the paragraph 3 on page 21, to read as follows:

The dark arrows [[50]] 50.1-50.5 of Figure 12 illustrate this transmission process as described above with respect to Figure 11. Figure 12 differs somewhat from the other figures in that Figure 12 illustrates that the resilient area 40.3 need not be located immediately beside the multi-axis hinge arrangement 1, but can be located anywhere on the closure parts so long as transmission of structural deformation and its attendant energy storage is guaranteed. In accordance with the teachings of the present application, through the use of known modeling techniques, the size of resilient areas, amount of energy stored therein, the amount of force transferred from the hinges, the location of the stable positions and virtually any other aspect of the hinges performance may be controlled.

30. Please amend the paragraph 1 on page 22, to read as follows:

The connecting elements 33.1, 33.2 in the embodiment of Figure [[2]] 12 are relatively thick planar plates which are torsionally stiff. The connecting elements 33.1, 33.2 are relatively flat on both surfaces thereof and the outer shape thereof is shaped conformally to the exterior of the closure so that the connecting elements 33.1, 33.2 may be optimally integrated to the outer

shape of the closure. Of course, the design of the cross-section of the connecting elements must consider the requirements of torsional stiffness, the tension and compression forces, and the shrinking behavior of the selected geometry. However, the principles described herein can be followed to achieve a hinge design having the desired performance characteristics.

31. Please amend the paragraph 3 on page 23, to read as follows:

The embodiment of Figure 13 further differs from the other embodiments in that the connecting elements 33.1, 33.2 are provided with a spatially curved "knee" shape such that their outer shape is conformally configured with the exterior design of the body 31 and its lid 32. An area along the longer knee shaped connecting element free edge 37, by virtue of the bend or knee in the connecting element ~~31.1 or 31.2~~ 33.1-33.2 can function, in part, as an accumulating buffer, illustrated as the resilient area 40.3. Thus, in this embodiment which employs a knee in the hinge connecting element, a portion of the energy for the snap effect may be stored by bending deformation within the hinge, itself.